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May 14, 2001

BOX PCT
Honorable Commissioner of
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Washington, D.C. 20231

PCT/DE99/03627
- filed 13 November 1999

Re: Application of Reinhard **JANSSEN,** Frank **LINDNER**
and Berthold **ULMER**
"METHOD FOR INCREASING THE POWER OF A TRAFFIC SIGN RECOGNITION SYSTEM"
Our Ref.: 3926.027

Dear Sir:

The following documents and fees are submitted herewith in connection with the above application for the purpose of entering the National stage under 35 U.S.C. §371 and in accordance with Chapter I of the Patent Cooperation Treaty:

- X this express request to immediately begin national examination procedures (35 U.S.C. 371(f)).
- X an executed Declaration and Power of Attorney.
- X a German Language International Application with European Search Report
- X an English (translation of the) International Application.
- ___ an English (translation of) Article 19 claim amendments.
- X English translation of Article 34 amendments (annexes to the IPER) and German language IPER.
- ___ an executed Assignment and PTO 1595 form.
- X Preliminary Amendment.

It is assumed that copies of the International Application, the International Search Report, the International Preliminary Examination Report, and any Articles 19 and 34 amendments as required by §371(c) will be supplied directly by the International Bureau, but if further copies are needed, the undersigned can easily provide them upon request.

The Government filing fee is calculated as follows:

Total claims	26	-	20	=	6	x $18	= $108.00
Independent Claims	2	-	3	=		x $80	= $
Base Fee							$860.00*
TOTAL FILING FEE							$968.00

* A copy of the European Search Report is attached.

A check for the statutory filing fee of $968.00 is attached. Please charge or credit any difference or overpayment to Deposit Account No. 16-0877. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §1.492 which may be required during the entire pendency of the application to said Account.

Priority is claimed from November 14, 1998, based on German Application No. 198 52 631.8.

Respectfully submitted,

PENDORF & CUTLIFF
Attorneys for Applicant

By _____
Stephan A. Pendorf
Registration No. 32,665

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09/831798
JC18 Rec'd PCT/PTO 14 MAY 2001

EXPRESS MAIL CERTIFICATE

"EXPRESS MAIL" MAILING LABEL NUMBER: **EL568147161US**

DATE OF DEPOSIT: **May 14, 2001**

I HEREBY CERTIFY that the foregoing cover letter including the German Language International Application with European Search Report, English Language translation with Verification Statement, Declaration and Power of Attorney, Preliminary Amendment, payment of fee, and a stamped receipt post card are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. §1.10 on the date indicated and is addressed: **ATTN: Box PCT, Commissioner of Patents and Trademarks, Washington, D.C. 20231.**

The Commissioner is hereby authorized to charge any additional fees which may be required at any time during the prosecution of this application without specific authorization, or credit any overpayment, to Deposit Account Number 16-0877.

Sherri A. Campbell

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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Reinhard **JANSSEN**, Frank **LINDNER**
and Berthold **ULMER**

Appln. No.:

Filed: **May 14, 2001**

For: **METHOD FOR INCREASING THE POWER OF A TRAFFIC SIGN RECOGNITION SYSTEM**

Attorney Docket No.: **3926.027**

PRELIMINARY AMENDMENT

Box: **PCT**
Honorable Commissioner of
Patents and Trademarks
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified application, please amend the application as follows:

IN THE SPECIFICATION:

Page 1, before paragraph [0001] insert:

--BACKGROUND OF THE INVENTION

Field of the Invention--

Page 1, paragraph [0001] delete "according to the precharacterizing portion of Patent Claims 1 and 10".

Page 1, before paragraph [0002] insert:

--Description of the Related Art--;

Page 1, before paragraph [0003] insert:

--SUMMARY OF THE INVENTION--

Page 1, before paragraph [0004] insert:

--DETAILED DESCRIPTION OF THE INVENTION--.

IN THE CLAIMS:

Page 9, line 1, please delete "PATENT CLAIMS" and insert therefore --What is Claimed is:--

Please cancel original Claims 1-23 and PCT Substitute Claims 1-23 and add the following new Claims 24-49 as follows:

--24. A process for improving performance of a system for recognizing traffic signs, said system including a camera and a therewith associated evaluation unit for image recognition or image display, said process comprising:

utilizing information originating from at least one of

(a) a map-based navigation system and

(b) a traffic information system

in the evaluation or display of contents of traffic signs.

25. A process according to Claim 24, wherein the system for recognition and/or display of traffic signs is in communication with the map-based navigation system or the traffic information system via an onboard data bus.

26. A process according to Claim 24, wherein the system for traffic sign recognition is capable of operating at a normal performance level and at least one enhanced performance level, and wherein said system is caused to operate at said enhanced performance level when it is determined on the basis of map-based information that the vehicle is passing through an area in which recognition of traffic signs may be problematic.

27. A process according to Claim 26, wherein within said problematic areas supplemental subdivided recognition processes are carried out, comprising:

a) when entering or leaving communities, carrying out a specific search for signs indicating entry of a community and leaving of a community,

b) when in the area of traffic influencing facilities, changing signs or traffic lights, searching for any change in the type and manner of the representation of the traffic signs,

c) when in an area in which poor visibility due to fog or rain may be present and a higher probability of contrast-poor images may be required, effecting an increase in the contrast enhancement of the image data.

28. A process according to Claim 24, wherein thereby characterized, that the type or the position or the condition or the visibility or the size of a recognized traffic sign is stored in a data storage unit associated with the map-based navigation system or the traffic information system.

29. A process according to Claim 28, further comprising emitting, by means of a signal producer contained in the display unit, an acoustic or optical signal when along an already traveled road segment a change with respect to the position or a change as to the presence or absence of a traffic sign occurs.

30. A process according to Claim 24, wherein the type and/or the position and/or the condition and/or the visibility and/or the size of a recognized traffic sign is stored in a data storage unit associated with the system for recognition of traffic signs.

31. A process according to Claim 30, further comprising emitting, by means of a signal producer contained in the display

unit, an acoustic or optical signal when along an already traveled road segment a change with respect to the position or a change as to the presence or absence of a traffic sign occurs.

32. A process according to Claim 24, wherein starting at the map-based navigation system or the traffic information system, a program for application of a decision logic is controlled in such a manner, that the image of the traffic sign is displayed for such a period, until a predetermined traveled path stored in the storage unit has been traveled.

33. A process according to claim 32, wherein said predetermined traveled path is dependent upon the class of traffic sign.

34. A process according to Claim 32, wherein said predetermined traveled paths are programmed into a data storage unit.

35. A process according to Claim 24, wherein the system for recognition of traffic signs, during the processing of image data provided by an image sensor,

examines these image data for the presence of traffic signs,

extracts data corresponding to traffic signs,

separates the extracted data into upper and lower classes and in association therewith extracts class-specific characterizing data, and

supplies these extracted class-specific characterizing data to a separate classification.

36. A process according to Claim 35, wherein the classification occurs hierarchically, in multiple classification steps.

37. A process according to Claim 35, wherein the classification steps are essentially set up follows:

a) first, only the characterizing data associated with the upper class of the object is supplied to a classifier,

aa) upon successful classification, wherein the class is recognized correctly with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the upper class stored in the memory unit,

ab) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the upper class and the charactering data for the lower class are replaced by the corresponding original image data originating from the image sensor,

b) if the classification of the upper class was successful, then subsequently the characterizing data associated with the lower class of the object are supplied to a classifier,

ba) upon successful classification, wherein the class is recognized with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the lower class stored in the memory unit,

bb) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence) the characterizing data for the lower class are substituted by the original image data from the image sensor.

38. A vehicle-mounted device for enhancing the performance of a system for recognizing traffic signs, which system includes a camera and a therewith associated evaluation unit for image recognition or for image display,

wherein said system is associated with at least one of (a) a map-based navigation system and (b) a traffic information system so as to utilize information originating therefrom in the process of recognition or display of contents of traffic signs.

39. A device according to Claim 38, wherein the system, the map-based navigation system, and/or the vehicle traffic information system are connected via an onboard data bus.

40. A device according to Claim 38, wherein the system for traffic sign recognition has the capacity to work at a base level of performance and an enhanced level of performance, and wherein said enhanced level of performance is engaged when, on the basis of map-based information, it is determined that the vehicle is passing through an area in which the recognition of traffic signs may be problematic.

41. A device according to Claim 38, wherein one of (a) the map-based navigation system and (b) the traffic information system is provided with a data storage unit, in which at least one of the type, the position, the condition, the visibility and the size of the recognized traffic sign is stored.

42. A device according to Claim 38, wherein the system for recognizing traffic signs is provided with a data storage unit, in which at least one of the type, the position, the condition,

the visibility and the size of the recognized traffic sign is stored.

43. A device according to Claim 38, wherein the display unit includes a signal emitter which emits an acoustic or optical signal when said vehicle travels along a previously traveled road segment and said system for recognizing traffic signs detects a change with respect to the position or the presence or absence of a traffic sign.

44. A device according to Claim 38, wherein a program for utilization of a decision logic is provided in the system, which program displays the image of a traffic sign until a predetermined path length, as determined by at least one of (a) the map-based navigation system and (b) the traffic information system, has been traveled.

45. A device as in Claim 44, wherein said predetermined path length is specific to the class of traffic sign.

46. A device according to Claim 44, wherein a memory unit is provided in the system, in which the predetermined path lengths are stored and via which they are made available for processing.

47. A device according to Claim 38, wherein a processing unit is provided in the system for recognition of traffic signs, which processing unit includes a program according to which it examines image data supplied by an image sensor for the presence of traffic signs, then extracts these data, separates these into upper and lower classes and in this context extracts class

specific characterizing data and separately supplies these to a classifier.

48. A device according to Claim 47, wherein this classifier is constructed hierarchically, in multiple classification steps.

49. A device according to Claim 48, wherein the classification steps are so constructed, that the classifier accomplishes the following functionalities:

a) first, only the characterizing data associated with the upper class of the object is supplied to a classifier,

aa) upon successful classification, wherein the class is recognized correctly with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the upper class stored in the memory unit,

ab) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the upper class and the charactering data for the lower class are replaced by the corresponding original image data originating from the image sensor,

b) if the classification of the upper class was successful, then subsequently the characterizing data associated with the lower class of the object are supplied to a classifier,

ba) upon successful classification, wherein the class is recognized with a high degree of confidence, the characterizing data are replaced by the appropriate

symbolic representation of the lower class stored in the memory unit,

bb) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence) the characterizing data for the lower class are substituted by the original image data from the image sensor.--

REMARKS

The specification and claims have been amended to conform the original translated specification and claims to U.S. requirements, i.e., appropriate section headers are added, reference in the specification to the claims have been amended in order to eliminate multiple dependent claims and claims improperly depending from multiple dependent claims, and to otherwise conform the claims to U.S. practice. Care has been taken to ensure that no new matter is added to the text.

Entry and favorable consideration prior to consideration are respectfully requested.

Respectfully submitted,

Stephan A. Pendorf
Registration No. 32,665

PENDORF & CUTLIFF
P.O. Box 20445
Tampa, Florida 33622-0445
(813) 886-6085

Date: **May 14, 2001**

U.S. Application No.:
PRELIMINARY AMENDMENT

Attorney Docket: 3926.027

EXPRESS MAIL CERTIFICATE

"EXPRESS MAIL" MAILING LABEL NUMBER: **EL568147161US**

DATE OF DEPOSIT: **May 14, 2001**

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Sherri A. Campbell

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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Reinhard **JANSSEN**, Frank **LINDNER**
and Berthold **ULMER**

Appln. No.:

Filed: **May 14, 2001**

For: **METHOD FOR INCREASING THE POWER OF A TRAFFIC SIGN RECOGNITION SYSTEM**

Attorney Docket No.: **3926.027**

VERIFICATION STATEMENT PURSUANT TO 37 C.F.R. §1.68

Box: **PCT**
Honorable Commissioner of
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Washington, D.C. 20231

Sir:

I, Stephan A. Pendorf, declare and state the following:

I am a citizen of the United States residing at 3940 Venetian Way, Tampa, Florida;

I have lived in Germany for 14 years and am familiar with both the German and English languages and have experience as a technical translator;

The attached English-language document is a full, true and faithful translation made by me of the text PCT Application No.: PCT/DE99/03627.

The attached English-language document is a full, true and faithful translation made by me of the Substitute Pages for PCT Application No.: PCT/DE99/03627.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these

statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of this application and of any patent issuing thereon.

Date: 5-14-01

Stephan A. Pendorf

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DATE OF DEPOSIT: **May 14, 2001**

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Sherri A. Campbell

09/831798
JC18 Rec'd PCT/PTO 1 4 MAY 2001

METHOD FOR INCREASING THE PERFORMANCE OF A TRAFFIC SIGN RECOGNITION SYSTEM

[0001] The invention concerns a process for improving the performance of a system for recognizing and/or indicating traffic signs according to the precharacterizing portion of Patent Claims 1 and 10.

[0002] Documents DE 3619824 C2 and DE 198 52 631 A1 disclose processes and devices which recognize, classify and cause to be displayed traffic signs extracted from images of traffic scenes. Herein the processes analyze the image data provided by image sensors without any pre-recognition regarding the actual scenario. For this reason these known processes are time consuming and require a high computer capacity and performance in order to be able to process this data in real time.

[0003] The task of the invention is thus to provide a process and a device, which enhances the performance of previously known systems for recognizing and displaying the contents of traffic signs. To accomplish this, on the one hand, the computer capacity and performance required for the real time operation must be reduced and, on the other hand, the display quality of the information contents of recognized traffic signs must be improved.

[0004] The task is solved by a process and a device, in which a system for recognizing and/or indicating traffic signals, the system including a camera and a therewith associated evaluation unit for image recognition and/or for image display, utilizes a map-based navigation system and/or information originating from a traffic information system in the recognition and/or the display of the content of traffic signs.

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[0005] In one conceivable embodiment of the invention the communication between the system for recognizing and/or display of traffic signs and the map-based navigation system or as the case may be the traffic information system occurs via a vehicle on-board data bus.

[0006] Preferably, the system for detection of traffic signs can be switched to enhanced performance when, on the basis of information as could be supplied by the map-based navigation system and/or the traffic information system, it can be determined that the vehicle is passing through an area in which a reliable detection of traffic signs may be problematic. Examples of such areas in which caution is to be taken include transition areas for entry and departure of residential areas. There signs can be found indicating entry of a residential area and departure from a residential area, which imply speed limitations or, as the case may be, lifting of the speed limitations. These signs are however not round as conventional, but rather square. The signs are easily confused with commercial signs, particularly when traffic sign recognition is carried out using monochrome cameras, since here the relatively significant yellow coloration of the signs cannot be used as a recognition criteria. A further area in which particular care is to be taken is the environment of traffic influencing-facilities and change or detour signs. Here one must presume special display and arrangement of the traffic signs, such as for example an intense representation of the black and white parts of the traffic sign as provided for improved night visibility. There is also an increased possibility of a suddenly occurring change or switching on of a traffic sign symbol, for example, sudden speed reduction to 120 km/h on highways. A particular type of traffic sign is a traffic light. In principle these can be classified with signs which change, since the condition of the display can change and therewith an increased observance is required. Using map-based information it

is however possible to operate the system with increased recognition performance for recognition of traffic signs in areas of traffic lights (intersections, train crossings).

[0007] While the above examples were concerned principally only with interaction with information from map-based navigation systems, examples of situations will be presented below in which increased recognition performance is required and which are advantageously associated with information originating from traffic information systems. This is essentially information advising that poor visibility due to fog or rain exists in certain regions traveled by the vehicle. In such a situation there is a presumption of increasingly poor contrast in the image data, so that the system for traffic sign recognition preferably must enhance the contrast improvement of the images. Preferably information regarding traffic jams is also taken into consideration, since here advanced notification can be given to the observer, in the form of the display of symbols of a traffic jam, a useful distance in advance of the traffic jam, without even having to pass such a traffic sign.

[0008] By this inventive possibility of temporarily varying the performance of the traffic sign recognition system, this opens the possibility of economically realizing a system for recognition of traffic signs. It is also advantageous that it is not necessary to provide a system, which in normal operating conditions is inadequately tasked and only in critical situations is completely occupied. Rather, the possibility is presented of using modern multi-processor data processing units taking advantage of the internal vehicle data communications and the number of available data processors present in modern vehicles to utilize the temporarily free, unutilized computer capacity in productive economic employment.

[0009] A further advantageous design characteristic of the invention is comprised therein, that information regarding the type and/or the position and/or the condition and/or the visibility and/or the size of a recognized traffic sign can be stored in an data storage unit. This data storage unit can either be associated with a map-based navigation system or, as the case may be, a traffic information system, or alternatively may be a component of the system for traffic sign recognition and/or display. By the integration of this data storage unit the observer can be alerted, via an acoustic or optical signal, to the fact that along a previously traveled path a change in respect to the position or the presence or absence of a vehicle sign has occurred. Thereby it is possible to alert the observer to, for example, construction-site-specific traffic regulations or, in the case of changed right-of-way, regulations in a crossing situation. It is further of advantage when, in the same manner, a warning signal is provided to the observer when the system for traffic sign recognition does not recognize an actual traffic sign or cannot classify it adequately.

[00010] The invention further provides benefits, when on the basis of the map-based position determination the possibility is presented to initiate or allow a program for use of a decision logic which limits the display a traffic sign for such a time, until a predetermined road distance has been traveled. This predetermined road distance is preferably classification specific and can be supplied using a storage unit or hard drive. For example in Germany the changing of streets is implicitly associated with the lifting of restrictions, such as speed limit restrictions. In addition, speed limits must be repeated at least every 3 km otherwise they are presumed to be rescinded. By this characteristic according to the invention it is achieved that a traffic sign can be displayed only as long as absolutely necessary even without explicit rescinding.

[00011] The invention has particularly advantageous benefits in combination with a system for recognition of traffic signs, in which the image data of the image sensor is analyzed and classified in an information-processing unit and, on the basis of the result, is stored in memory as image data representing class-specific image segments and/or symbolic figures, which are then displayed by means of the display unit. Therein, in the framework of the analysis by the information-processing unit, it is determined whether the image data of the image sensor contains one or more objects, which with sufficiently high probability are traffic signs. Consequently the so-detected objects are forwarded to a further processing and classification step. In a particularly advantageous manner, in the framework of the invention, during the further processing of the image data of the objects, a separation is undertaken into the traffic sign specific upper classes and lower classes. Thereby appropriate classification-specific characteristic data are extracted and relayed to a separate classification. Depending on whether the classification specific characteristic data are correctly recognized with high probability during the classification, they are replaced by the corresponding or appropriate symbolic image representing image data stored in the storage unit or by the appropriate original image data stemming from the image sensor. The image data resulting from the dissections are recombined into a synthetic image of a traffic sign and this image is then stored in the memory unit and brought to the display by means of the display unit.

[00012] An important advantage of the invention is comprised therein, that it is no longer necessary to carry out the computer taxing and with high error quotient associated problem of classification of a relatively complex traffic sign which must be solved over its entirety, rather the problem, by separation of

the detected objects into traffic sign specific upper classes and lower classes in a preceding classification process, is dissected or redirected to clearer and therewith simpler classification problems. Therewith in like measure the demands on the necessary computing power and the image quality are reduced.

[00013] A brief example will now be given using a speed limit sign for the separation of the traffic sign into traffic sign specific upper classes and lower classes. The traffic sign specific upper class of this traffic sign belongs to the class of regulating signs, which have a characteristic round shape with an internal symbol therein. In this special cases of a traffic speed limiting sign, the integrated symbol is a number which is circumscribed by a broad, red ring. In the case of this traffic speed limit indicating sign the internally lying symbol, that is the indication as to the speed to which a vehicle speed is to be limited, is an element of the traffic sign specific lower class.

[00014] In the system for traffic sign recognition, with which advantageously the invention for improving the performance of a system for recognition and/or display of traffic signs can be combined, it should now be possible with comparatively low computer power and with low equipment expense (for example, a monochrome camera instead of a high resolution color camera) to check in real time whether the object of a particular shape within the detected or observed image is an actual traffic sign. If this is the case, then the classification specific characteristic data of the object are supplied to a separate classification for identification of the traffic sign. Generally a hierarchically organized classifier is employed for identification of the traffic sign. The classification occurs therein in multiple steps. For this, first the characteristic data or features associated with the upper class of the object are supplied to the classification. If a classification occurs

successfully (that is, the class could be correctly recognized with high confidence), then the characteristic data are replaced by the appropriate symbolic representation of the object stored in the memory unit. If the classification is unsuccessful (that is, the class could not be recognized with high confidence), then the characteristic data of the upper class and the characterizing data of the lower class are replaced by the original image data originally stemming from the image sensor and the image classification process is ended. A further step within the classification procedure is initiated when the classification of the upper class was successful. In this case, the characterizing data belonging to the lower class of the object are subsequently supplied to a classifier. In the case of successful classification of this lower class (that is, the class could be recognized with high confidence), then the characterizing data are replaced by the appropriate or corresponding symbolic representation of the lower class stored in the memory unit. On the other hand, in the case of unsuccessful classification (that is, the class could not be recognized with high confidence) the characterizing data of the lower class is replaced by the corresponding original image data stemming from the image sensor.

[00015] With this hierarchical process a low error rate traffic sign recognition is provided. Therein both hierarchical steps for identification of the upper class or as the case may be the identification of the lower class may themselves again be hierarchically organized. With respect to the design of the classifiers employed within the hierarchical classification it is conceivable to so design these, that they make decisions on the basis of a comparison of the distance of the characterizing data supplied to them from the class typical characterizing data sets stored in the memory unit. Thereby the traffic sign identifying object is assigned to that respective upper class, to which the distance in the measurement space is the lowest. Thereby it is

possible to so define a tolerance threshold which is compared with a minimal distance value, wherein the distance value falling below the tolerance threshold serves as indicator to a high probability of correct occurrence of recognition. In another advantageous design it is also possible to so design the classifiers, that they can be trained with the aid of a traffic sign specific learning succession of passes. This process is particularly advantageous, since the quality of the image data delivered by the image sensor depends strongly upon the environmental factors such as weather and light relationships.

Copy provided by USPTO from the PIRS Image Database on 04/14/2004

Patent Claims:

1. Process for improving performance of a system for recognizing and/or displaying traffic signs, which includes a camera and a therewith associated evaluation unit for image recognition and/or image display, thereby characterized, that the system utilizes information originating from at least one of a map-based navigation system and/or a traffic information system in the evaluation and/or display of contents of traffic signs.

2. Process according to Claim 1, thereby characterized, that the system for recognition and/or display of traffic signs is in communication with the map-based navigation system and/or traffic information system via an onboard data bus.

3. Process according to Claim 1 or 2, thereby characterized, that the system for traffic recognition begins to operate at an enhanced performance when it is determined on the basis of map-based information that the vehicle is passing through area in which recognition of traffic signs may be problematic.

4. Process according to one of Claims 1 through 3, thereby characterized, that within problematic areas supplemental subdivided recognition processes are carried out, in such a manner that

a) in the area of community entrances and community exits there is a specific search for signs indicating entry of a community and leaving of a community,

b) in the area of traffic influencing facilities, changing signs or traffic lights, separately attention is paid to a change in the type and manner of the representation of the traffic sign,

c) in an area, in which poor visibility due to fog or rain is present and a higher probability of contrast-poor images

must be calculated with, preferably an increase in the contrast enhancement of the image data is effected.

5. Process according to one of the preceding claims, thereby characterized, that the type and/or the position and/or the condition and/or the visibility and/or the size of a recognized traffic sign is stored in a data storage unit associated with the map-based navigation system or, as the case may be, the traffic information system.

6. Process according to one of the preceding claims, thereby characterized, that the type and/or the position and/or the condition and/or the visibility and/or the size of a recognized traffic sign is stored in a data storage unit associated with the system for recognition of traffic signs.

7. Process according to one of Claims 5 or 6, thereby characterized, that by means of a signal producer contained in the display unit, an acoustic or optical signal is emitted when, along an already traveled road segment, a change with respect to the position or a change as to the presence or absence of a traffic sign occurs.

8. Process according to one of the preceding claims, thereby characterized, that via a program stored in the storage unit a decision logic is controlled, via which the information processing unit controls the display unit in such a manner, that it displays the synthesized image of the traffic sign so long, until a predetermined traveled path stored in the storage unit is traveled, which is preferably class specific.

9. Process according to Claim 8, thereby characterized, that the predetermined traveled paths are programmed into a data storage unit.

10. Process according to one of the preceding claims, thereby characterized, that the system for recognition of traffic signs, during the processing of image data provided by an image sensor, examines these for the presence of traffic signs, then extracts these, separates these into upper and lower classes and in association therewith extracts class-specific characterizing data, which are then supplied to a separate classification.

11. Process according to Claim 10, thereby characterized, that the classification occurs hierarchically, in multiple classification steps.

12. Process according to Claim 11, thereby characterized, that the classification steps are essentially set up follows:

a) first, only the characterizing data associated with the upper class of the object is supplied to a classifier,

aa) upon successful classification (i.e., the class could be recognized correctly with a high degree of confidence) the characterizing data are replaced by the appropriate symbolic representation of the upper class stored in the memory unit,

ab) upon unsuccessful classification (i.e., the class could not be correctly recognized with a high degree of confidence) the characterizing data for the upper class and the charactering data for the lower class are replaced by the corresponding original image data originating from the image sensor,

b) if the classification of the upper class was successful, then subsequently the characterizing data associated with the lower class of the object are supplied to a classifier,

ba) upon successful classification (i.e., the class could be recognized with a high degree of confidence) the characterizing data are replaced by the appropriate symbolic representation of the lower class stored in the memory unit,

bb) upon unsuccessful classification (i.e., the class could not be correctly recognized with a high degree of confidence) the characterizing data for the lower class are substituted by the original image data from the image sensor.

13. Device for enhancing the performance of a system for recognizing and/or displaying traffic signs, which includes a camera and a therewith associated evaluation unit for image recognition and/or image display, thereby characterized, that the system is associated with at least one of a map-based navigation system and/or a traffic information system, in order to utilize information originating therefrom in the recognition and/or the display of contents of traffic signs.

14. Device according to Claim 13, thereby characterized, that the connection between the system for recognizing and/or display of traffic signs and the map-based navigation system and/or the vehicle traffic information system is via an onboard data bus.

15. Device according to Claim 13 or 14, thereby characterized, that the system for traffic sign recognition has the capacity to work with highened performance when, on the basis of map-based information, it is determined that the vehicle is passing through an area in which the recognition of traffic signs may be problematic.

16. Device according to one of the preceding claims, thereby characterized, that the map-based navigation system or, as the

case may be, the traffic information system, is provided with a data storage unit, in which the type and/or the position and/or the condition and/or the visibility and/or the size of the recognized traffic sign is stored.

17. Device according to one of the preceding claims, thereby characterized, that the system for recognizing of traffic signs is provided with a data storage unit, in which the type and/or the position and/or the condition and/or the visibility and/or the size of the recognized traffic sign is stored.

18. Device according to one of Claims 16 or 17, thereby characterized, that the display unit includes a signal emitter which emits an acoustic or optical signal when along an already traveled road segment a change occurs with respect to the position or the presence or absence of a traffic sign.

19. Device according to one of the preceding claims, thereby characterized, that a program for utilization of a decision logic is provided in the system for recognizing and/or displaying traffic signs, which displays the image of a traffic sign until a predetermined path length, based upon the map-based navigation system and/or the traffic information system, has been traveled, which is preferably class specific.

20. Device according to Claim 16, thereby characterized, that a memory unit is provided in the system for recognition and/or providing traffic signs, in which the predetermined path lengths are stored and via which they are made available for processing.

21. Device according to one of the preceding claims, thereby characterized, that a processing unit is provided in the system for recognition of traffic signs, which processing unit examines image data supplied by an image sensor for the presence of

traffic signs, then extracts these data, separates these into upper and lower classes and in this context extracts class specific characterizing data and separately supplies these to a classifier.

22. Device according to Claim 21, thereby characterized, that this classifier is constructed hierarchically, in multiple classification steps.

23. Device according to Claim 22, thereby characterized, that the classification steps are so constructed, that the classifier accomplishes the following functionalities:

a) first, only the characterizing data associated with the upper class of the object is supplied to a classifier,

aa) upon successful classification (i.e., the class could be recognized correctly with a high degree of confidence) the characterizing data are replaced by the appropriate symbolic representation of the upper class stored in the memory unit,

ab) upon unsuccessful classification (i.e., the class could not be correctly recognized with a high degree of confidence) the characterizing data for the upper class and the charactering data for the lower class are replaced by the corresponding original image data originating from the image sensor,

b) if the classification of the upper class was successful, then subsequently the characterizing data associated with the lower class of the object are supplied to a classifier,

ba) upon successful classification (i.e., the class could be recognized with a high degree of confidence) the characterizing data are replaced by the appropriate symbolic representation of the lower class stored in the memory unit,

bb) upon unsuccessful classification (i.e., the class could not be correctly recognized with a high degree of confidence) the characterizing data for the lower class are substituted by the original image data from the image sensor.

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ABSTRACT

The invention relates to a method and device that increase the performance of prior art systems that recognize and display the contents of traffic signs. The invention reduces the amount of computer capacity required for real time operation and improves the display quality of the contents of known traffic signs. The system for recognizing and/or displaying traffic signs comprises a camera and an evaluation unit connected thereto for image recognition and/or display. Said system uses information stemming from at least one map-based navigation system and/or one travel information system in order to recognize and/or display the contents of traffic signs.

Copy provided by USPTO from the PIRS Image Database on 06/23/2005

METHOD FOR INCREASING THE PERFORMANCE OF A TRAFFIC SIGN RECOGNITION SYSTEM

[0001] The invention concerns a process for improving the performance of a system for recognizing and/or indicating traffic signs according to the precharacterizing portion of Patent Claims 1 and 10.

[0002] Documents DE 3619824 C2 and DE 198 52 631 A1 disclose processes and devices which recognize, classify and cause to be displayed traffic signs extracted from images of traffic scenes. Herein the processes analyze the image data provided by image sensors without any pre-recognition regarding the actual scenario. For this reason these known processes are time consuming and require a high computer capacity and performance in order to be able to process this data in real time.

Japanese document JP 06348991 discloses a system and a process for recognizing traffic signs, wherein the system employs a color camera and a therewith associated evaluation unit for image recognition. The invention is concerned with the task of, by evaluating the color information from the image information, automatically recognizing lane boundaries and devices for regulating traffic. Herein however there is no supplementation of the image information from the color camera with information from a map-based navigation system or a traffic information system for enhancing the recognition performance of the system.

New Patent Claims (PCT Substitute Page entered November 7, 2000):

1. Process for improving performance of a system for recognizing traffic signs, which includes a camera and a therewith associated evaluation unit for image recognition or for image display, thereby characterized, that the system utilizes information originating from at least one of a map-based navigation system or a traffic information system in the evaluation or display of contents of traffic signs.

2. Process according to Claim 1, thereby characterized, that the system is in communication with the map-based navigation system or the traffic information system via an onboard data bus.

3. Process according to Claim 1 or 2, thereby characterized, that the system for traffic sign recognition begins to operate at an enhanced performance when it is determined on the basis of map-based information that the vehicle is passing through area in which recognition of traffic signs may be problematic.

4. Process according to one of Claims 1 through 3, thereby characterized, that within problematic areas supplemental subdivided recognition processes are carried out, in such a manner that

a) in the area of community entrances and community exits there is a specific search for signs indicating entry of a community and leaving of a community,

b) in the area of traffic influencing facilities, changing signs or traffic lights, separately attention is paid to a change in the type and manner of the representation of the traffic sign,

c) in an area, in which poor visibility due to fog or rain is present and a higher probability of contrast-poor images

must be calculated with, preferably an increase in the contrast enhancement of the image data is effected.

5. Process according to one of the preceding claims, thereby characterized, that the type or the position or the condition or the visibility or the size of a recognized traffic sign is stored in a data storage unit associated with the map-based navigation system or the traffic information system.

6. Process according to one of the preceding claims, thereby characterized, that the type or the position or the condition or the visibility or the size of a recognized traffic sign is stored in a data storage unit associated with the system for recognition of traffic signs.

7. Process according to one of Claims 5 or 6, thereby characterized, that by means of a signal producer contained in the display unit, an acoustic or optical signal is emitted when, along an already traveled road segment, a change with respect to the position or a change as to the presence or absence of a traffic sign occurs.

8. Process according to one of the preceding claims, thereby characterized, that starting at the map-based navigation system or the traffic information system, a program for application of a decision logic is controlled in such a manner, that the image of the traffic sign is displayed for such a period, until a predetermined traveled path stored in the storage unit is traveled, which is preferably class specific.

9. Process according to Claim 8, thereby characterized, that the predetermined traveled paths are programmed into a data storage unit.

10. Process according to one of the preceding claims, thereby characterized, that the system for recognition of traffic signs, during the processing of image data provided by an image sensor, examines these for the presence of traffic signs, then extracts these, separates these into upper and lower classes and in association therewith extracts class-specific characterizing data, which are then supplied to a separate classification.

11. Process according to Claim 10, thereby characterized, that the classification occurs hierarchically, in multiple classification steps.

12. Process according to Claim 11, thereby characterized, that the classification steps are essentially set up follows:

a) first, only the characterizing data associated with the upper class of the object is supplied to a classifier,

aa) upon successful classification, wherein the class could be recognized correctly with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the upper class stored in the memory unit,

ab) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the upper class and the charactering data for the lower class are replaced by the corresponding original image data originating from the image sensor,

b) if the classification of the upper class was successful, then subsequently the characterizing data associated with the lower class of the object are supplied to a classifier,

ba) upon successful classification, wherein the class could be recognized with a high degree of confidence,

the characterizing data are replaced by the appropriate symbolic representation of the lower class stored in the memory unit,

bb) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the lower class are substituted by the original image data from the image sensor.

13. Device for enhancing the performance of a system for recognizing or displaying traffic signs, which includes a camera and a therewith associated evaluation unit for image recognition or for image display, thereby characterized, that the system is associated with at least one of a map-based navigation system or a traffic information system, in order to utilize information originating therefrom in the recognition and/or the display of contents of traffic signs.

14. Device according to Claim 13, thereby characterized, that a connection is made via an onboard data bus between the system, the map-based navigation system and/or the vehicle traffic information system is.

15. Device according to Claim 13 or 14, thereby characterized, that the system for traffic sign recognition has the capacity to work with highened performance when, on the basis of map-based information, it is determined that the vehicle is passing through an area in which the recognition of traffic signs may be problematic.

16. Device according to one of the preceding claims, thereby characterized, that the map-based navigation system or, as the case may be, the traffic information system, is provided with a data storage unit, in which at least one of the type, the

position, the condition, the visibility and the size of the recognized traffic sign is stored.

17. Device according to one of the preceding claims, thereby characterized, that the system for recognizing of traffic signs is provided with a data storage unit, in which at least one of the type, the position, the condition, the visibility and the size of the recognized traffic sign is stored.

18. Device according to one of Claims 16 or 17, thereby characterized, that the display unit includes a signal emitter which emits an acoustic or optical signal when along an already traveled road segment a change occurs with respect to the position or the presence or absence of a traffic sign.

19. Device according to one of the preceding claims, thereby characterized, that a program for utilization of a decision logic is provided in the system, which displays the image of a traffic sign until a predetermined path length, based upon the map-based navigation system or the traffic information system, has been traveled, which is preferably class specific.

20. Device according to Claim 16, thereby characterized, that a memory unit is provided in the system, in which the predetermined path lengths are stored and via which they are made available for processing.

21. Device according to one of the preceding claims, thereby characterized, that a processing unit is provided in the system for recognition of traffic signs, which processing unit examines image data supplied by an image sensor for the presence of traffic signs, then extracts these data, separates these into upper and lower classes and in this context extracts class

specific characterizing data and separately supplies these to a classifier.

22. Device according to Claim 21, thereby characterized, that this classifier is constructed hierarchically, in multiple classification steps.

23. Device according to Claim 22, thereby characterized, that the classification steps are so constructed, that the classifier accomplishes the following functionalities:

a) first, only the characterizing data associated with the upper class of the object is supplied to a classifier,

aa) upon successful classification, wherein the class could be recognized correctly with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the upper class stored in the memory unit,

ab) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the upper class and the charactering data for the lower class are replaced by the corresponding original image data originating from the image sensor,

b) if the classification of the upper class was successful, then subsequently the characterizing data associated with the lower class of the object are supplied to a classifier,

ba) upon successful classification, wherein the class could be recognized with a high degree of confidence, the characterizing data are replaced by the appropriate symbolic representation of the lower class stored in the memory unit,

bb) upon unsuccessful classification, wherein the class could not be correctly recognized with a high degree of confidence, the characterizing data for the lower class are substituted by the original image data from the image sensor.

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DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name: that I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural names are listed below) of the subject matter claimed and for which a patent is sought in the application entitled:

METHOD FOR INCREASING THE POWER OF A TRAFFIC SIGN RECOGNITION SYSTEM

which application is:
✓ the attached application
(for original application)

___ Based on Application No. _____
filed _____ and amended on
_____
(for declaration not accompanying application)

that I have reviewed and understand the contents of the specification of the above-identified application, including the claims, as amended by any amendment referred to above; that I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56, that I hereby claim foreign priority benefits under Title 35, United States Code §119, §172 or §365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified on said list any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application on which priority is claimed:

Application No.	Country	Filing Date	Priority Claimed (yes or no)
198 52 631.8	Germany	November 14, 1998	yes

I hereby claim the benefit of Title 35, United States Code §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in a listed prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge my duty to disclose any material information under 37 C.F.R. §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application No.	Filing Date	Status (patented, pending, abandoned)

(3)

I hereby appoint Stephan A. Pendorf, Reg. No. 32,665; Yaté K. Cutliff, Reg. No. 40,577 and Evelyn A. Defillo, Reg. No. 45,630, my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and request that all correspondence about the application be addressed to Stephan A. Pendorf at Pendorf & Cutliff, P.O. Box 20445, Tampa, FL 33622-0445.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1 of 2

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DECLARATION AND POWER OF ATTORNEY

3 —

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